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A CONTRIBUTION TO THE BIOLOGY OF THE PIED CROW *CORVUS ALBUS* MÜLLER IN UGANDA

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INTRODUCTION

The Pied Crow is the most widely distributed corvid in Uganda. It occurs in virtually all parts of the country, but especially in association with human settlements. The population of these birds in Kampala has been estimated to be between 600 and 800 birds (Pomeroy, in prep.), the density being particularly high in the central part of the city.

In comparison with some other corvids, there is little information available in literature on the biology of the Pied Crow. It is widespread in Africa south of the Sahara except where there is desert or tropical forest (Mackworth-Praed and Grant, 1963). Pied Crows have received the attention of research workers mainly because of their feeding habits. Among the types of food that they are reported to eat are agricultural crops like maize, and young domestic fowls and eggs (Priest, 1936). On occasions, Pied Crows attack lambs and peck them to death, pulling their eyes out (Hey, 1966), a habit reported about other corvids in Britain and Australia (Holyoak, 1968; Rowley, 1969). In addition, Priest (1936) suggested that they eat insects off cattle and wild animals. The period of egg-laying seems to vary from place to place, being in January in Uganda, western Kenya and the Sudan, and in November in eastern Kenya (Mackworth-Praed and Grant, 1963). Nests are usually constructed in the branches of lofty trees (Clancey, 1964; Mackworth-Praed and Grant, 1963) but some nests have been found near the ground (Priest, 1936) and others on telephone poles—a rather unusual site (Clancey, 1964).

This study of the crow populations in and around Kampala was made between July and October 1970. The main areas of study were at Wandegeya, the refuse tips at Kololo and Mengo-Natete, and Makerere.

MATERIAL AND METHODS

(*a*) Population counts

Crow counts were made twice a week at the roost at Wandegeya and once a week at the rubbish dumps. The counts were made using a pair of binoculars and a hand tally counter.

The roost at Wandegeya is a small *Eucalyptus* stand of trees planted mainly along roads, occupying about 10 ha. Apart from a large number of crows inhabiting it at night, the roost is used by about 30 Hooded Vultures *Necrosyrtes monachus* about 15 Hadada Ibises *Hagedashia hagedash*, a few Black-and-white Casqued Hornbills *Bycanistes subcylindricus* and a number of bats (Microchiroptera).

In the evening the crows fly to areas surrounding the roost from where they fly singly, in twos or small flocks to the roost. Counting at the roost was timed to start when the number of crows in the neighbouring area was observed to be low, i.e. between 18.45 and 18.55 hrs and usually took about 15 minutes. A path covering the whole roost was devised from which most of the trees occupied by the crows could be observed.

At each tree, I stood directly below the canopy and counted the birds rapidly clockwise round the canopy. *Eucalyptus* trees lend themselves to this kind of counting since they have thinly distributed lanceolate leaves so that birds sitting on branches are distinct when viewed against the sky.

At the refuse tips the weekly count was made once between 09.00 and 10.00 hrs local time, and on a few occasions several times a day.

(*b*) Behavioural studies

Whenever counts were made at the roost and at the rubbish dumps, notes were made about behaviour. In addition, the behaviour of four crows in cages was studied, though not quantitatively. The four birds were caught in a trap similar to the one suggested by Hollom (1950). The crows were later ringed, their white chest and collar dyed pink, and released for observations in the field.

(*c*) Examination and dissection

Twenty-six crows were shot between July and October 1970 near the roost at Wandegeya and two others were shot at the Kololo rubbish dump. Since a large proportion of the population in Kampala may be roosting at Wandegeya, the crows that were obtained from there are likely to be representative of the population around the city. One bird, which probably had been hit by a stone, was obtained from Lugala (west of Kampala). When the birds were received, they were put into a plastic bag and sealed to avoid loss of ectoparasites. The weight of the birds as well as the lengths of the body, wings, wing span, tarsi and tail were recorded. Ectoparasites from the birds were collected and fixed in 70% ethanol. If the birds were not to be dissected immediately, they were stored in a deep-freeze.

On dissection, the major organs—the alimentary tract, trachea, lungs, and liver—and the abdominal and synovial fluid cavities were examined—and any endoparasites found in them were fixed in 70% ethanol. Thin and thick smears of blood from the heart were made on slides and examined for microfilariae and other blood parasites.

Food from the gizzard was put into a petri-dish and washed several times until all digested and crushed floating material was removed. The remaining food was identified as far as possible under a binocular microscope, and the types of food constituting the highest percentage were recorded as the bulk. The types of food occurring in small quantities were also recorded in detail.

The reproductive condition of the birds was assessed from the size of the gonads which were weighed. As there could be a correlation between the reproductive condition of a bird and moulting, the flight feathers of the birds were examined for any signs of moult. A scale, devised by Ashmole (1962) and also used by Ingolfsson (1970), was used to classify these feathers according to their age.

RESULTS

(*a*) Measurements

The major problem in making studies on the Pied Crow in the field (especially on behaviour) is that there is no difference in the plumage of the sexes. Therefore, measurements were made with the object of determining whether there was a size difference between the sexes. The measurements indicated that males are larger than females (Fig. 1 (*a*)) but the difference is too slight to assist identification in the field.

Some of the measurements made are regarded as not being reliable because they are affected by other factors as well as the accuracy of measuring. The wing length is dependent upon the moult stage of the bird. If the distal primaries are young, or old and torn at the ends, the wing length will be shorter than when they are just mature. The total length of the bird and the wing span depend on how hard the wings and the neck respectively are stretched, and it is difficult to standardize the stretch. However, the bill, tail and tarsal lengths, and the weight are regarded as being more reliable than the first three measurements (the tail feathers do not break much at the tips).

If the more reliable of the measurements are pooled, they may be of some use on trapped birds. The pooling has been done by expressing each measurement as a percentage of twice the mean of all the birds that were examined. The mean of these percentages for a single bird is referred to as the size statistic of the bird. This statistic separates the sexes better than any single measurement (Fig. 1(*b*)), although not completely. Crows with a size statistic larger than 50 per cent are likely to be males, while the majority of crows with a size statistic smaller than this are females. The three males that had a size statistic smaller than 50 per cent had testes weighing 0.01g, 0.02g, and 0.03g each, which is at the lower range of weight of testes of males (0.01-0.1g) that were not in reproductive condition. For the only fledgling that was caught (it had difficulty in flying and perching), apparently only the vasa deferentia had developed. The fledgling had a size statistic of 48%, which is not different from those of the three small males in Fig. 1(*b*). It is probable that these small males were sub-adults.

(*b*) Food

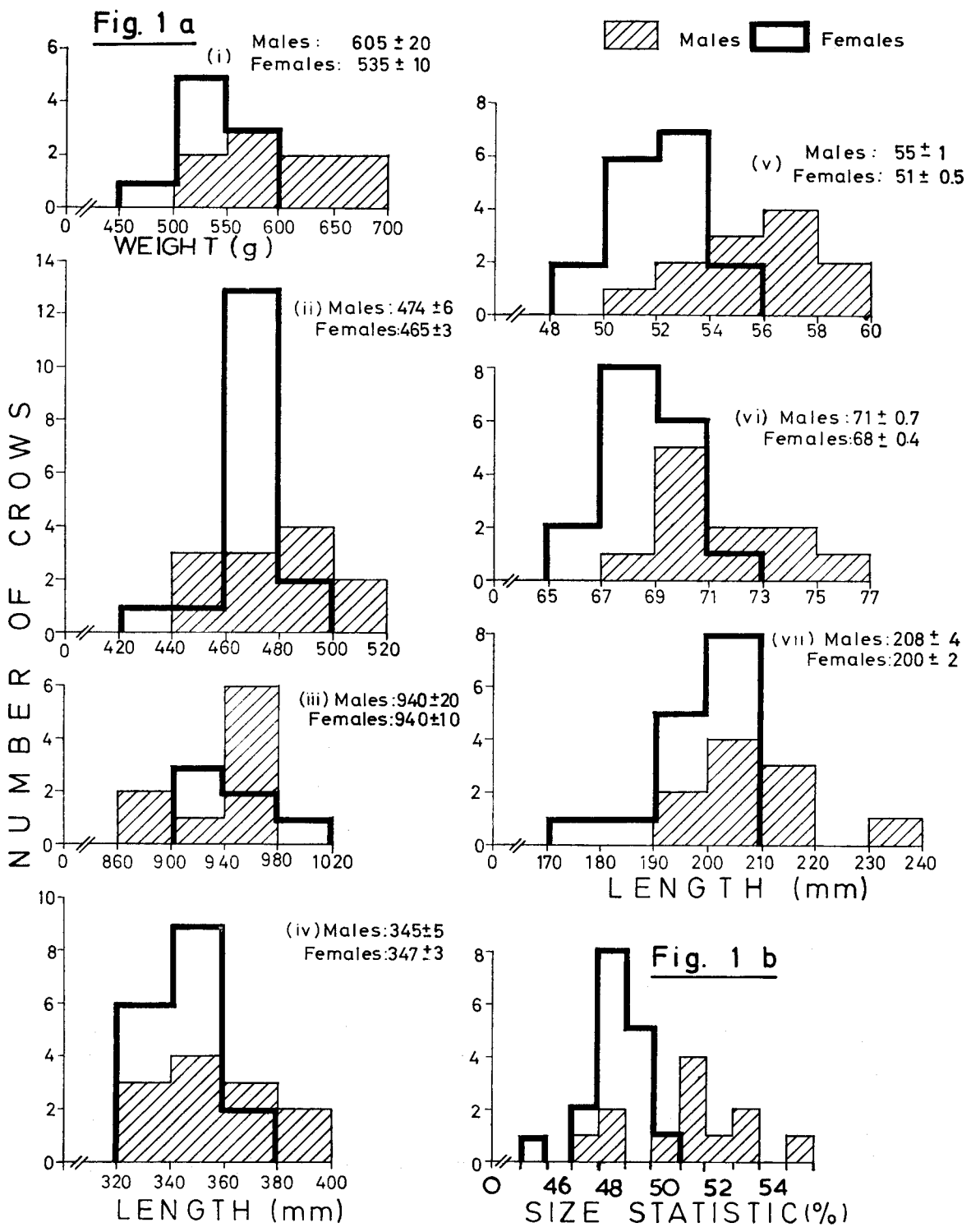
There seems to be a wide variety of types of food eaten by crows (Table 1), which includes plant and animal food and carrion. Some of the material occurring in small quantities, like laterite stones, may be eaten unintentionally in the process of eating other types of food. However, crows have been observed tearing up and eating butter wrappings. Small quantities have been found in their gizzards.

Of the bulk food found in the gizzard, the type that occurred most frequently was groundnuts. Most of these groundnuts were raw but in a few cases they had been roasted. The period of survey was the time when groundnuts were harvested and sold at trading centres. It is likely that the crows obtained them either from the farms around Kampala or from trading centres. The roasted groundnuts may have been obtained from dustbins or from refuse tips.

(*c*) Breeding and moulting

When observations were started in July 1970, there was much twig-carrying activity. This continued to be intense until October. After this period, twig-carrying crows were seen infrequently. The observations were discontinued in January 1971, and there is therefore no information about the intensity of this activity between then and June.

This twig-carrying activity is an indication that the crows are building nests or repairing used ones in preparation for breeding. However, only six nests (four at Makerere, one at Wandegeya and one near the Mengo-Natete refuse tip) were observed



FIGURES

1*a*. The differences in size and weight between male and female Pied Crows: (i) weight, (ii) total length, (iii) wing span, (iv) wing length (v) bill length, (vi) tarsal length and (vii) tail length.

1*b*. A combination of the more reliable measurements—bill, tarsal and tail lengths (Fig. 1*a* v, vi and vii. Also see text).

to be in use. All these nests were high up on lofty *Eucalyptus* trees, constructed in a fork of branches or among many small delicate branches, which made them inaccessible. One of the nests at Makerere disintegrated (apparently after use) and on the ground were many *Eucalyptus* twigs, small bits of cloth and feathers probably used in lining the nest. The rest of the nests, when viewed through binoculars, also seemed to be composed of *Eucalyptus* twigs.

Crows have ten primary and ten secondary remiges (the last 3 or 4 are usually referred to as 'tertials'), and twelve rectrices. Crows examined at the same time were found to be at widely different stages of shedding their flight feathers. Since moulting usually follows breeding, the wide difference in the moult stages of crows at any one time may be a reflection of more or less continuous breeding throughout the year.

TABLE 1

Gizzard Contents

Type of Food	*Total no. of crows*	*% of crows with food*	*% of crows having food*	
			As Bulk	*In small quantities*
Vegetable Food				
Groundnuts	6	21	21	0
Potatoes (cooked)	3	10	10	0
Wild dates	4	14	10	3
Cassava (cooked)	2	7	7	0
Maize meal (posho)	3	10	7	3
Maize grains	3	10	3	7
Cabbages	1	3	3	0
Grass blades	7	24	3	21
Flowers (stamens)	2	7	0	7
Rice (cooked)	1	3	0	3
Wild berries	1	3	0	3
Tomatoes	1	3	0	3
Grums	1	3	3	0
Unidentifiable Vegetable matter	3	10	7	3
Animal Food—Prey animals				
Egg shell fragments	8	20	18	10
Green caterpillars	6	21	14	7
Young birds	4	14	3	10
Ants	7	24	3	21
Termites	2	7	3	3
Dipteran Larvae	1	3	3	0
Beetles	1	3	0	3
Animal Carrion				
Fish carrion	4	14	0	14
Meat, small bones	6	21	7	14
Unidentifiable Animal matter	3	10	3	7
Dead Organic or Inorganic Material				
Small stones (Laterite)	3	10	0	10
Small stones (Limestone)	4	14	0	14
Butter wrappings	1	3	0	3
Thin white paper	1	3	0	3
Pieces of wood	1	3	0	3

On the wing, moulting starts from two points—at the base of the wing and at the carpal joint. The moult of the primary remiges starts at the carpal joint and proceeds outwards to the end of the wing. Moulting of the secondary remiges starts at both ends of the secondary remex tract. Therefore, this tract has two moult waves: the proximal one which starts at the base of the wing and proceeds outwards, and the distal one which starts at the carpal joint and proceeds inwards. The two waves converge and meet at the 5th and 6th secondary remiges. The moult of rectrices starts at the centre of the rectrix tract and proceeds outwards. The moulting seems to be synchronous in both wings and on both sides of the tail.

As to the sequence of events during a complete moult of the flight feathers in a crow, it seems that the primary remex moult starts first and ends last, during which period the secondary remiges and rectrices are shed as is true of many passerines. The growth rate of the 9th and 10th primaries, which was measured from captured birds in cages, is about 12 cm per month (Fig. 2). Therefore, it seems that a single long remex (about 16–17 cm from the calamus) takes about 40 days to mature. This figure should be regarded with caution since the growth rate of remiges of birds in the wild could be different from that of cage birds. Nevertheless, from this growth rate and from the size-gradation of growing remiges and rectrices of the birds examined, the period taken for the crows to moult has been estimated.

The moult of primary remiges, which takes the longest time, is completed in about 100 days (just over 3 months) while that of the secondary remiges and the rectrices takes about 50 days (nearly 2 months). This period is short compared with its relative, the Raven, which is 140-150 days (Snow, 1970).

The only crow examined which was in reproductive condition (a male with large testes each weighing ca. 1g) had mature, slightly old flight feathers. In addition, birds examined in August and September 1970 gave a relatively higher moult score than those examined in July and October 1970 (Fig. 3). This suggests that there were relatively more birds with mature flight feathers in these months than in the months before or after it. Since this was the period of marked twig-carrying and nestbuilding activities this indicates that crows may shed flight feathers before or after breeding. In the Raven, wing moult begins at about the same time as the hatching of young (Snow, 1970).

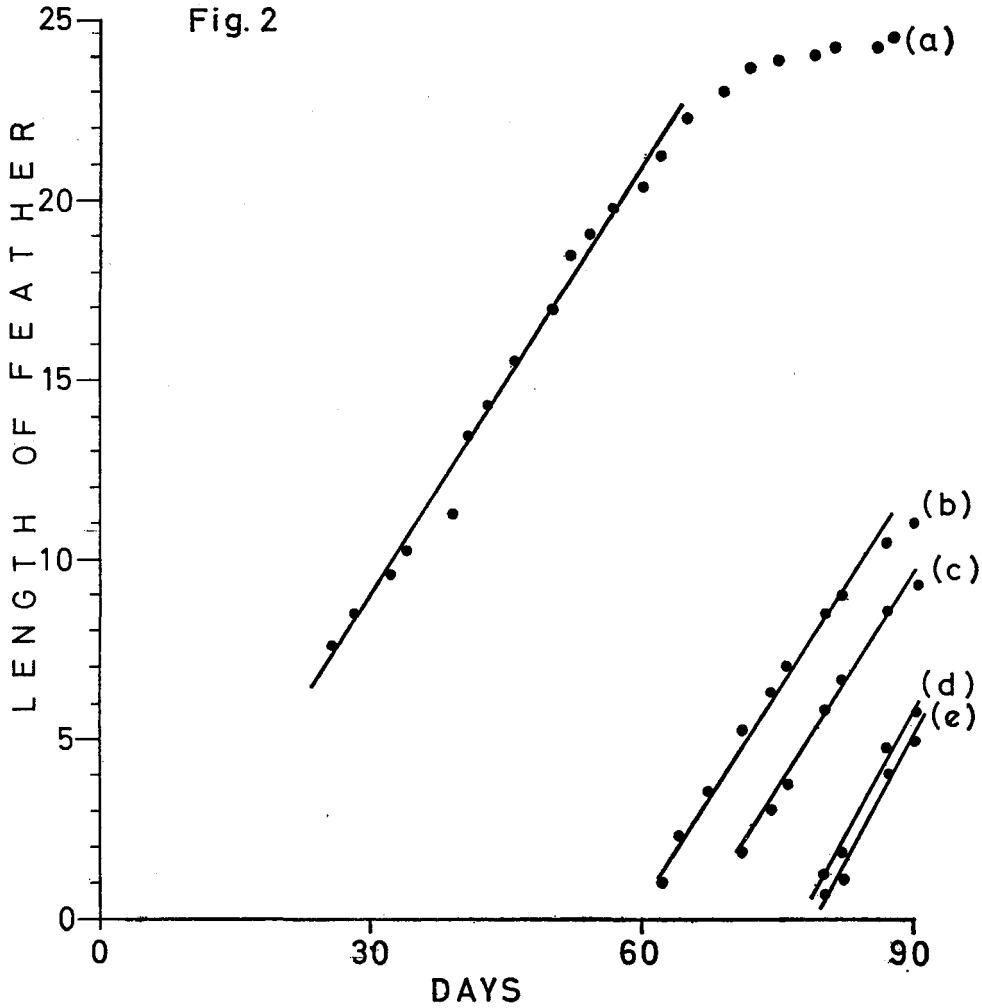
(*d*) **Behaviour**

(i) *Pair bond and degree of social behaviour*

Pied Crows are more often seen singly or in pairs than in flocks, which suggests that there is a formation of a pair bond. Sexual display and courtship have been observed between birds of a pair indicating that the pair are a male and a female. During courtship, the male raises the coverts of the chest, neck and head, and elevates its head while facing the female. It then takes a few steps, lowers its head with a fully stretched neck and, with the bill pointing straight at the female, it bends down into a half-crouching position, with the wings lowered, and makes a low but loud "coow, coow" call. Afterwards, the male rises from the half-crouching position, takes a few steps backwards and repeats the same sequence of acts. This performance may be repeated a number of times before the male jumps onto the female to effect copulation, which may be successful if the female does not jump away from its position.

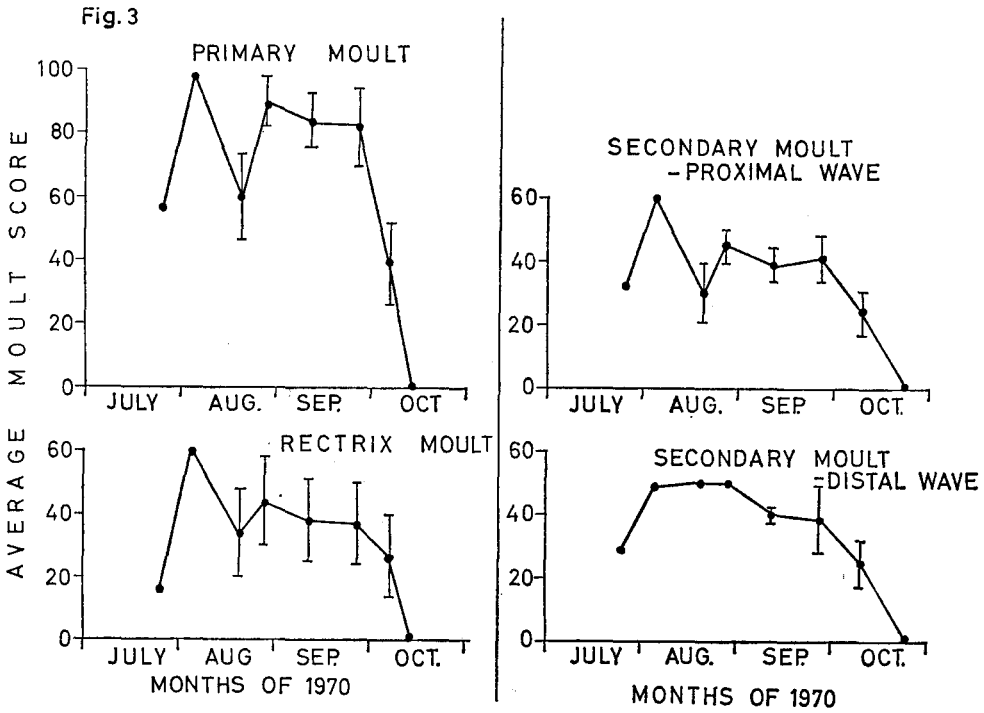
Further, a form of sexual display has been observed at feeding grounds. One of the birds (probably male) stands beside the other (probably female) with its legs wide apart, the head elevated and the coverts of the chest, neck and head feathers raised. It then lowers the head and points the bill directly down between its legs, after which it rapidly tosses the head into the air. This performance is repeated several times rapidly and can be likened to the bird pecking at something between its legs and tossing it into the air. Afterwards, the displaying bird moves closer to the other bird and steps on its leg. On several occasions, the other bird has been observed jumping away a number of times to free its legs. This display was not followed by an attempt by the 'male' to mount the 'female'.

Pied Crows may form flocks which can be as large as forty birds. This occurs especially when they are feeding or soaring, or when returning to the roost. Sometimes, the crows form a large irregular circle while soaring in the evening, displaying what Wynne-Edwards (1962) refers to as "crow's weddings or parliaments". This tendency to social behaviour is also displayed when one of the crows is in trouble; other crows then attempt to come to its aid. Whenever the trap was set and crows were caught, a large number of others gathered around the trap. If I approached, the group of crows outside would start jumping up and down calling excitedly to those crows in the trap.



The growth of flight feathers of captive Pied Crows (length in millimetres)

First bird:	(*a*)	left 9th primary remex,
	(*b*)	right 10th " "
	(*c*)	left 10th " "
Second bird:	(*d*)	left 9th " "
	(*e*)	right 9th " "



3. The means of moult scores of Pied Crows that were examined. Standard deviations are also included where several birds were obtained at the same time.

Eventually, the crows flew away to a distance of about ten metres from where they watched the proceedings. Meanwhile, the birds in the trap were restless, but they did not call even when caught and removed from the trap. When the crows were placed in cages, other crows sometimes gathered around the cages. At times when the ones in the cages were being handled (i.e. being measured, dyed or ringed) those outside would start calling loudly while flying round and round the cages. This sometimes made the captive birds more aggressive, so that they called, clawed and bit viciously.

(ii) *Daily pattern of activities*

As morning approaches, the crows start calling from the roost. Calling starts at about 05.00 hrs, but it is not until 06.00 hrs that they start flying about in the roost. Some start flying away singly, in pairs or in threes, or occasionally in small flocks to neighbouring trees and buildings, or to distant places. About half an hour after the birds start flying, they leave the high buildings and trees, and alight on the ground to start feeding.

Feeding is intensive for the first three to four hours. At each of the rubbish dumps at Kololo and Natete, there can be as many as 30 crows feeding on the refuse. As the sun gets hot, the crows leave exposed feeding grounds and continue feeding in shady areas around homesteads, under trees in compounds, in hedges, plantations and so on. Some rest in trees, making strange sounds, or perform aerial acrobatics or just soar higher and higher in the sky. On cloudy days they stay longer on exposed feeding grounds.

Feeding becomes intensive again in the afternoon and early evening. Around 18.00

hrs, the crows start flying to trees and buildings around the roost, such as Mulago Hospital (about ½ km from the roost) where the number of crows may exceed a hundred. From here they start flying to the roost singly, in pairs or threes, or sometimes in small flocks. Some crows in the roost may fly back to Mulago, so that there is a constant interchange of birds flying to and from the roost. But gradually the numbers around Mulago diminish and by about 19.05 hrs all the crows have left the area for the roost. Counts at the roost showed that there are between 450 and 500 crows inhabiting it at night.

On some evenings, the crows may be restless. They fly from one tree to another causing crows already on it to fly into the air, fly round and come back to the same or another tree, 'cawing' excitedly causing more and more crows to fly into the air, until the flock is large. Sometimes crows on the whole roost get up in this way; they fly in one direction and as they go, groups break off and wheel back to the roost. This causes intense activity and unrest in the roost, with crows coming back and trying to settle down, but being caused to fly away again by other returning crows. This intense activity dies down gradually as it gets dark, and by 19.30 hrs the crows have settled down for the night, although an odd pair can be seen now and then, flying from one part of the roost to another.

This calling and flocking together of crows in the roost is similar to what Wynne-Edwards (1962) refers to as epideictic displays, which he suggests are associated with population control measures employed by the species. He is of the opinion that the display enables the crows in the roost to assess the size of the population and thereby get adjusted to a breeding level which will not cause over-crowding.

(iii) *Voice*

The method used to describe sounds made by crows will be that referred to by Hold (1970) as the subjective syllabic method, which, according to him, is still valid in spite of the many developments in the technique for refining bird-song analysis.

The crows make the well-known "caaw", described by Williams (1963) and many others as a harsh guttural call, and described by Clancey (1964) as a simple "kwaak". The "caaw" is varied according to the situation:

(*a*) When crows are at, or near, the nest and a person approaches they make a long rising "caaw" which sounds like a complaining note.
(*b*) When the crows seem to be excited or frightened, the "caaw" is short, repeated many times and more or less just "ca-ca-ca-ca".
(*c*) When a crow is calling its mate, it makes a straight-forward long "caaw, caaw, caaw", repeated usually twice or three times.
(*d*) When feeding or looking for food, the crow may make "caaws" of various kinds.
(*e*) When crows are fighting, they make the sharp "ci-i-i-i" of falling pitch.

In addition, crows make the sound "coow" as has been mentioned above. This sound is probably made by males alone during courtship. Earlier, Priest (1936) noted that this sound is made only during the breeding period or at the peak of breeding. Here, two males have been observed making it during courtship.

On several occasions a distant crow has been heard making the sound "cio, cio", the significance of which has not been discovered.

There are two other distinct sounds whose significance is not known. One of them is the guggling noise "cororororo—carararara" which crows make during the day when they are sitting in the canopy of trees. It could be a sound of satisfaction. However, crows have been seen making this sound when feeding or looking for food. An unsettled juvenile was seen making many variations to the "caaw" call, and at the same time attempting to make the "corororo-carararara" which resulted in queer noises. Another

sound is the "ce-ce-ce" pause, "ce-ce-ce-ce" pause etc. As the crow makes this noise it half spreads its wings.

Chamberlain, *et al.* (1968) examined the syringeal anatomy of the Common Crow, *Corvus brachyrhynchos*, and found that it has seven muscles, sufficient to give the crows considerable ability to vary their sound. A casual inspection of the syringeal anatomy of the Pied Crow indicates a similarity with that of the Common Crow.

(iv) *Relations with man and other animals*

In their daily foraging activity, crows come into close proximity with human beings. They are seen feeding in markets near fish stands, butcheries and dustins; the people do not seem to molest or to pay particular attention to them. This may be due to people being accustomed to seeing these birds foraging, and the birds becoming conditioned to this apparent harmlessness of man.

On the two occasions that crows were caught in the trap, the crows that gathered around the trap did not attack me when I approached, although they put up a tumult of calls. But the crows in the cages, although they did not attack me, showed some form of threat display, especially after they had been handled. This display was in the form of momentarily raising the feathers of the chest, neck and head. One instance was when two crows were on one perch and one of them displayed in this way. To see how the two birds would behave when faced with a threat from me, I made an attempt to drive them off the perch. I waved my hands in the air which made the bird that had not displayed fly off the perch, but not the one that had displayed. I moved closer to within arm's reach of the perch and extended a twig to push the bird off the perch, but the crow simply bit the twig viciously and did not move. This suggests that the display is some form of threat behaviour.

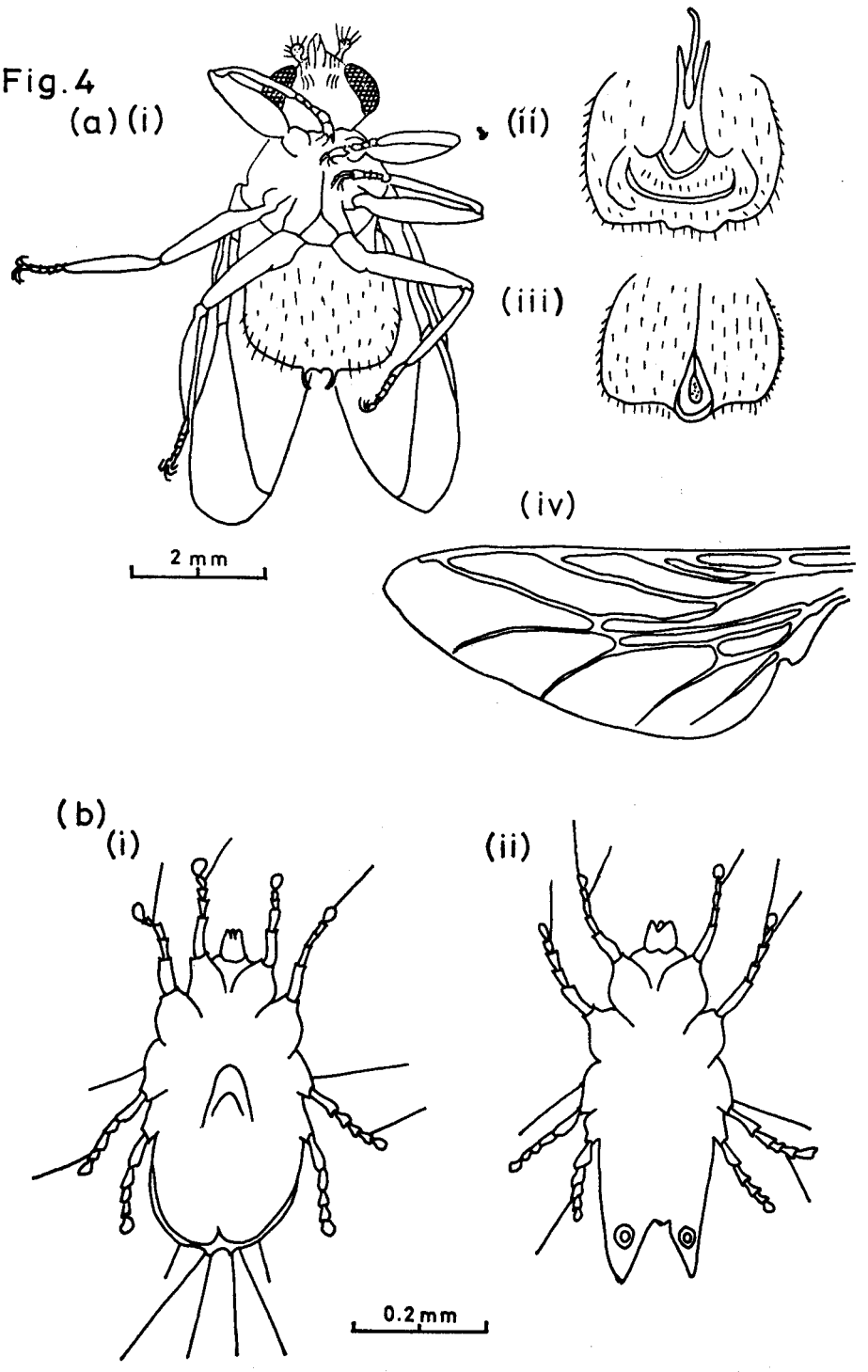
The crows behaved in a variety of ways towards other animals. Whenever a dog passed the cages, crows in the cages would 'caw' and jump up and down. Near refuse tips, crows have been observed to fly round and round a dog, calling and sometimes diving at it. Aggressive behaviour of crows towards dogs may be a result of the competition for food that occurs at the feeding ground, where dogs sometimes chase birds off food. This apparent competition also occurs between birds of different species, i.e. crows, Marabous, kites and vultures. Marabous often drive crows off food by clattering their bills. But kites and crows frequently chase each other for food. Crows and vultures rarely chase each other, probably because vultures do not persist in chasing crows when the latter have got food.

Furthermore, crows perform a type of behaviour, the pulling of tails, the significance of which is yet unknown. One sunny afternoon when a group of Marabous were kneeling and resting after feeding, a crow stealthily walked up behind one of them and pulled its tail until the stork stood up. The crow then trotted to the next stork and repeated the tail-pulling act. The crow performed this act to all the storks in the group, after which it trotted off to feed at the rubbish tip. Crows pull the tails of vultures too and neither species chases the crows after this tail-pulling act. The crows have not been observed pulling the tails of kites which, however, are on the wing most of the time. On one occasion, a crow was observed attempting to pull a cat's tail! (Pomeroy, pers. comm.).

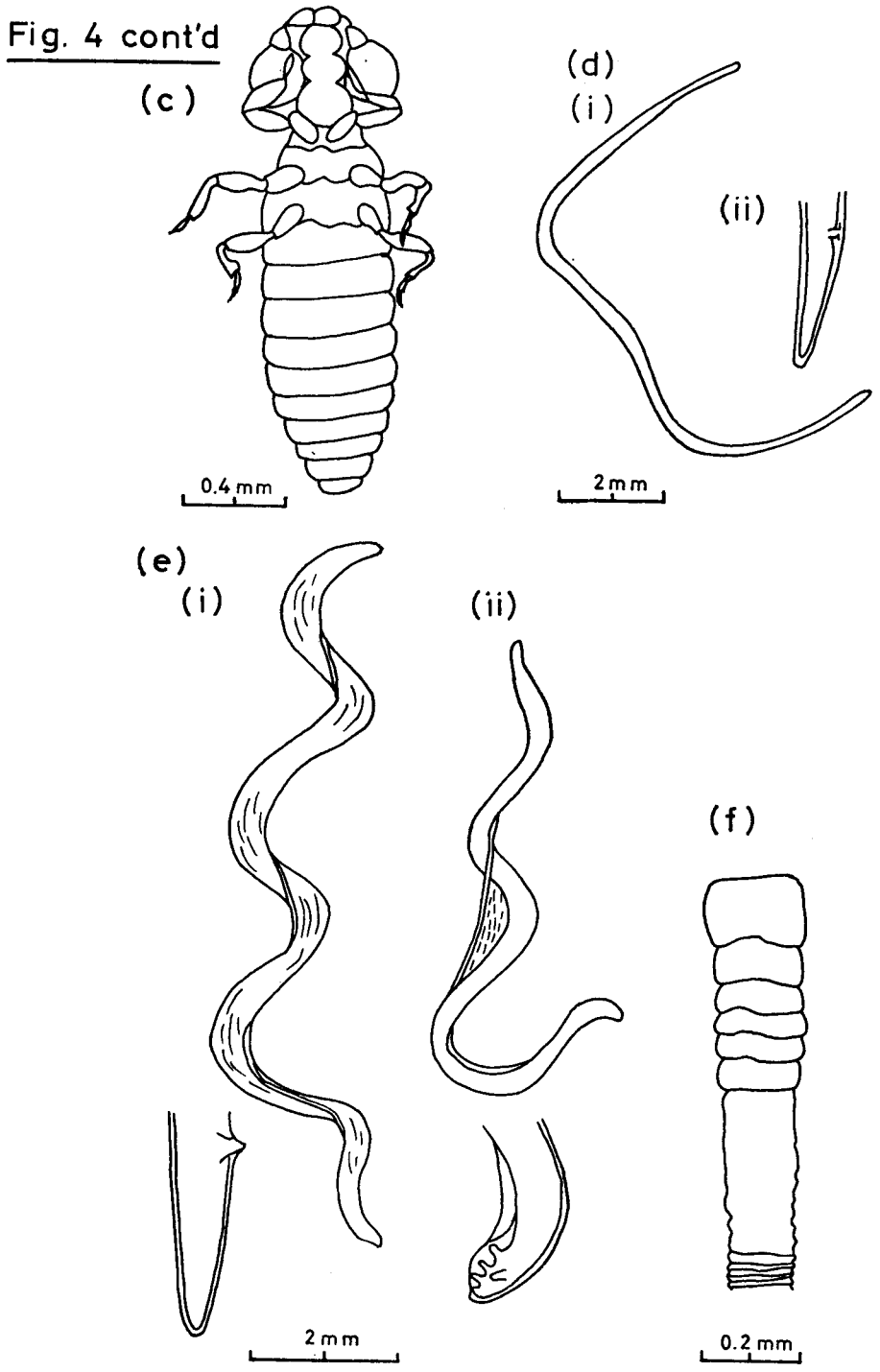
(*e*) **Parasites** (Fig. 4)

Ectoparasites that were found on crows included listerophorid mites, lice (Mallophaga) pupiparan flies and a tick (Table 2). The mites were found lodged in between barbs of the remiges, near the rachis, while the tick was found on the chin. One crow which lacked a lower jaw was highly infested with lice. This high infestation is likely to be a result of the crow being unable to remove the lice by preening. This condition is characteristic of many birds with bill abnormalities (Pomeroy, 1962).

The only endoparasites found in crows were tapeworms (in the small instestine)



Parasites of Pied Crows. (*a*): (i) female Pupiparan fly, (ii) abdomen of male with aedeagus extended, (iii) aedeagus withdrawn, (iv) wing of fly. (b) Listerophorid mites (i) female, (ii) male.



(*c*) Mallophaga. (*d*) nematodes from body cavity (i) whole worm, (ii) hind end. (*e*) Filaroid worms from synovial cavity of tarsometatarsus: (i) female, (ii) male (with insets of hind end). (*f*) scolex of tapeworms.

and nematodes (in the abdominal cavity, and in the synovial fluid cavity of the tibiotarsal joint). The tapeworms are long, measuring about 40 cm. The birds that had nematodes in the synovial fluid cavity, had microfilariae in the blood too, which suggests that these are filaroid nematodes. Their presence in the synovial cavity, was sometimes associated with broken connective tissue which possibly came from the ligamentous aponeurosis.

TABLE 2

Degree of infestation of crows by parasites

Parasite	*No. of infested birds*	*% of infested birds*	*Degree of infestation (No./bird)*
Tt. j. nematodes	9	35	2-51
B.C. nematodes	2	6	1-5
Tapeworms	11	38	1-9
Mites	27	93	Many
Lice	26	90	Usually many
Pupiparan flies	8	28	1-3
Ticks	1	3	1

Total No. of Crows was 29.
Tt. j. = tibiotarsal joint
B.C. = body cavity

DISCUSSION

Although Pied Crows are found in most areas in Uganda, large numbers are found mainly in towns. This is largely a result of the urban areas having plenty of refuse and animal carrion which the birds feed upon. In Kampala, the number of Pied Crows that feed at rubbish tips is only a small proportion (about 1/40th) of the population of crows in the city (Pomeroy, in prep.). The rest are to be found foraging in the densely populated areas of the city. From here, they remove discarded bits and pieces of food, animal carrion and vegetable matter, which would otherwise cause a health hazard to the urban population.

Another beneficial aspect of crows to man is in their catholic feeding habit. Among the many types of food they eat are caterpillars (lepidopteran larvae) some of which could be pests on some agricultural crops, and larvae of dipterans (flies) which could be vectors of human diseases. Therefore, the crows have adapted to living in urban areas not only to their own benefit but also to that of the ever-increasing urban human population.

SUMMARY

The Pied Crow population in and around Kampala was studied and data have been presented on the following aspects: size of crows, food, breeding, moulting, parasites, and behaviour—pair bonding, social behaviour, daily pattern of activities, voice and relations with man and other animals.

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